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Effect Of Magnetic Treatment On Seed Germination Of Mung Bean (Vigna Radiata)

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Abstract

The effect of stationary magnetic field on seed germination of Mung bean (Vigna radiata) seeds was examined under Normal Laboratory Conditions (NLC). Mung (Vigna radiata) seeds were exposed to magnetic field of strength 1.5 mT for time duration of 15 minute, 20 minute and 25 minute. Under normal laboratory conditions, seed germination rate, root length and stem length were monitored and measured. The results revealed that Mung Bean (Vigna radiata) seed with magnetic treatment shows noticeable change for germination rate, root length, and stem length compared to NLC. The magnetic field exposure of 1.5 mT for 25 minute resulted in a greater germination rate than the NLC. It was observed that the root and stem lengths were increased. Remarkable changes were observed in protein analysis for magnetically treated seeds compared to NLC seeds.

Key words - Magnetic field, Seed Germination, Vigna radiata, Protein.

I. Introduction

Any gardener and farmer desire for faster, better and bigger plants with higher yields. A magnetic field MF can be considered as an inevitable environmental aspect for plants on the Earth. Through the tenure of evolution process, all living organisms experience the action of the geomagnetic field, GMF, which is a natural component of their environment. GMF is steadily acting on living systems, and is known to influence many biological processes as well. Local variations in the strength and direction of the earth's magnetic field are significant. At the surface of the earth, the vertical component is maximal at the magnetic pole, amounting to about 67μT and is zero at the magnetic equator. The horizontal component is maximal at the magnetic equator, about 33μT, and is zero at the magnetic poles[1]. We know that, the earth has two geographical poles namely North Pole and South Pole. The north pole-oriented magnet implies a significant change in the average height of the plant[2]. Magnetic field and its effect on plant growth and quality characteristics is a new field of research that is increasingly gaining the interest of researchers in agronomic science [3]. The plants did not remain indifferent to the magnetic field effect. Their reaction depended on the direction of the magnetic field [4].
Pre-sowing seeds are exposed to the magnetic field because magnetic treatment before sowing seeds is of effective, affordable and secure method which can improve post-germination plant expansion and crop

production [5].The magnetic pretreatment of coffee seeds to optimize germination is still an emergent process [6]. Effect of magnetic field on seed germination and seedling growth of sunflower is studied [7]. Effect of magnetic field on seed germination, growth and yield of Sweet Pepper (*Capsicum annuum* L.) [8]. Effect of magnetic field treatments on seed germination of Lemon Balm (*Melissa officinalis* L.) is described. [9] Effect of Silver nanoparticles and Pb $(NO_3)_2$ on the yield and chemical composition of Mung bean is studied [10]. Cell phone radiations affect early growth of *Vigna radiata* L. (Mung bean) is studied through biochemical alterations by V.P. Sharma et. al.[11]. R. Radhakrishnan is studied in details that how magnetic field regulates plant functions, growth and enhances tolerance against environmental stresses [12].

More research is also needed to test whether irrigating tomato plants with magnetically treated saline solutions may improve plant growth and productivity under greenhouse conditions [13]. Limited studies related to the biochemical and physiological aspects of magnetic seed stimulation on oil seeds have been reported so far and concentrated mainly on cereals and root crops [14]. The review of the available literature shows that there were no reports on the impact of ferromagnetic particles on the germination of seeds and the growth of plants in the presence of constant magnetic fields. Not many reports exist concerning the concentrations of selected elements in the seeds and seedlings subjected to magnetic fields [15].Some authors have used statistical and mathematical functions to analyze seed germination curves, such as Logistic function [16]. Seed vigor and vitality are lost in storage due to deterioration, which ultimately results in loss of expensive seed material [17]. The primary objectives of this work are to evaluation the root length, shoot length, fresh mass, dry mass , and protein analysis of mung bean seeds and examine the impact of varying static magnetic field exposure times on these germination parameters.

II. Materials and Methods

2.1 Seed Sample:

Good quality Mung bean (*Vigna radiata*) seeds were purchased from Devkishanji Vaktaji and Sons, Station Road, Himmatnagar, Sabarkantha District, Gujarat, India. These seeds were exposed to magnetic field in normal laboratory environment at Department of Physics, D. L. Patel Science College, Himmatnagar, District - Sabarkantha, Gujarat, India.

2.2. Magnetic Field Generation:

The aim of this study is to observe the effect of magnetic field on the early stages of development of Mung seed. A set up consists of a pair of electromagnet, ammeter, voltmeter and power source were used for giving magnetic treatment to seeds and is shown in Figure 1. Seeds under investigation were exposed to 1.5 mT magnetic field for different time duration.

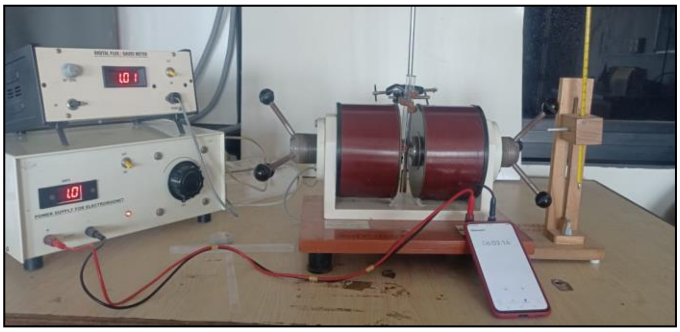

Figure-1: Experimental Set up for magnetic treatment

2.3 Treatment Procedure:

Mung seeds were used as the test material in this study and four groups were sprouted with distilled water at the initial temperature of 28 °C for 24 h after germination. The samples under study were exposed to 1.50 mT magnetic field generated by an electromagnet for different time periods (15,20, 25 minutes). Seeds after magnetic treatment were distributed into three different group for each time duration. One set in each group was taken as control (without magnetic treatment). The Petri dishes were labeled as P-1: Control (without magnetic treatment), P-2: 1.5 mT for 15 min exposure, P-3: 1.5 mT for 20 min exposure and P-4: 1.5 mT for 25 min exposure. Table 1 represents the climatic factors of control and treatment of Mung seeds. The morphology of the Mung seeds in all Petri dishes was studied after seven days. Same climatic factors were maintained for both control and magnetically treated seeds.

Table 2.1 Climatic Factors

No.	Item	Control	Treatment
1	Temperature	30° C	30° C
2	Humidity in %	58% to 60%	17.2 to 18.2 g/m^3
3	Illumination	598	598 lux

Table 2.1 displayed climatic factors like Temperature, Humidity, and Illumination for control seeds and seeds under treatment.

The above factors indicated that the values of temperature were 30 degree Celsius and Humidity was near to 58% to 60% and Illumination (LUX) was 598.

III. Results and Discussion

Germination of Mung seeds were observed on alternate day for seven days. Parameters like root length, shoot length and protein percentage were observed and noted. Remarkable changes were noticed. The results obtained are presented here and discussed.

3.1 Root Length:

Table 3.1 shows the measurement of root length of Mung beans as control and exposed to 1.5 mT magnetic field for various time duration. The graphical representation of these measurements is shown in Figure 2. After 7 days of observation, as mentioned in above table and figure, it is clear that root length is increased by 12% in group P2, 21% in group P3 and 29% in group P4 comparison to control P1 for exposure of 1.5 mT magnetic fields.

Table 3.1 The Root length of Mung Beans

Exposure Time in min	Treatment	Root Length in mm			
		In Days			
		1	3	5	7
Control	P1	3	12	19	24
15	P2	4	14	21	27
20	P3	4	15	25	29
25	P4	5	16	28	**31**

Table 3.1 displayed that The Root length of Mung Beans exposed to 1.5 mT magnetic fields. After applied the magnetic field P1 treatment show that root length was 24 mm, P2 treatment showed that root length was 27 mm, P3 treatment showed that root length was 29 mm and P4 treatment showed that root length was 31 mm.

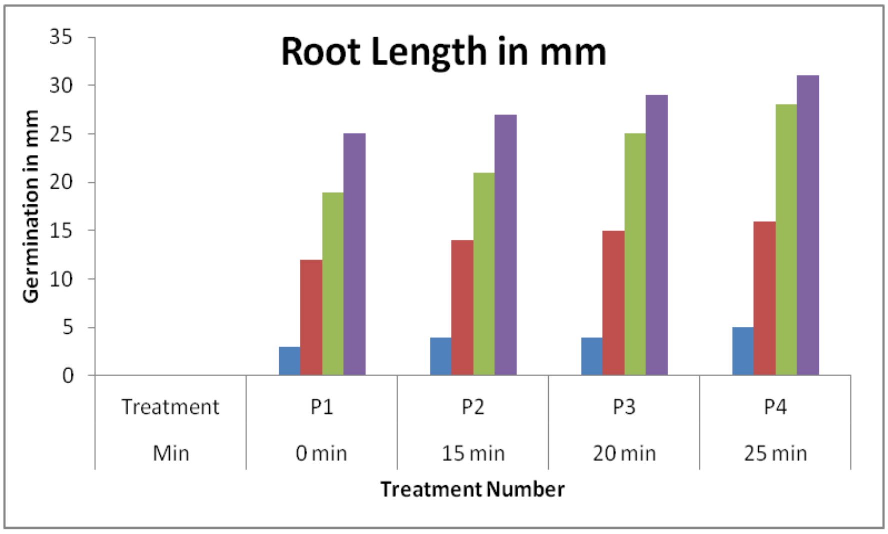

Figure-2 The graphical representation of root length of Mung beans for various time duration.

3.2 Shoot Length

The measurement of shoot length of Mung beans as control and exposed to 1.5 mT magnetic field for various time duration is shown in Table 3.2. The graphical representation of these measurements is shown in Figure 3. After 7 days of observation, as mentioned in above table and figure, it is clear that shoot length is increased by 9% in group P2, 18% in group P3 and 29% in group P4 comparison to control P1 for exposure of 1.5 mT magnetic field.

Table 3.2: The Shoot length of Mung Beans.

Exposure Time in min	**Treatment**	**Root Length in mm In Days**			
		1	**3**	**5**	**7**
Control	P1	8	24	32	45
15 min	P2	9	26	36	49
20 min	P3	11	29	39	53
25 min	P4	16	33	42	**58**

Table 3.2 displayed that The Shoot length of Mung Beans exposed to 1.5 mT magnetic fields. After applied the magnetic field P1 treatment show that shoot length was 45 mm, P2 treatment showed that shoot length was 49 mm, P3 treatment showed that shoot length was 53 mm and P4 treatment showed that shoot length was 58 mm.

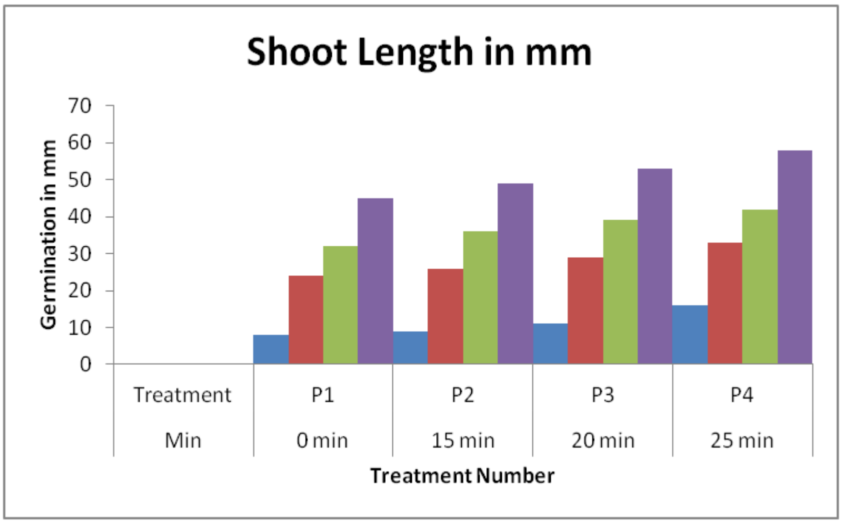

Figure 3: The graphical representation of shoot length of Mung beans for various time duration.

3.3 Protein Percentage

The Kjeldahl technique was used to assess the amount of protein in Mung seeds. The percentage of protein is calculated using the following equation (1) [18].

$$\text{Percentage of Protein} = [6.25 * N\%] \qquad (1)$$

Where N is the nitrogen percentage and 6.25 is denoted the protein-nitrogen conversion factor.

Table 3.3 the protein percentage of Mung Beans.

		Protein in Percentage (%)	
Min	Treatment	With Water	Without Water
Control	P1	21.3	21.1
15 min	P2	21.6	21.4
20 min	P3	22.2	22.1
25 min	**P4**	**22.4**	**22.3**

Table 3.3 showed that The Protein Analysis in percentage of Mung Bean with and without water. Result indicated that there was changing in control and P1, P2, P3 with water and without water.

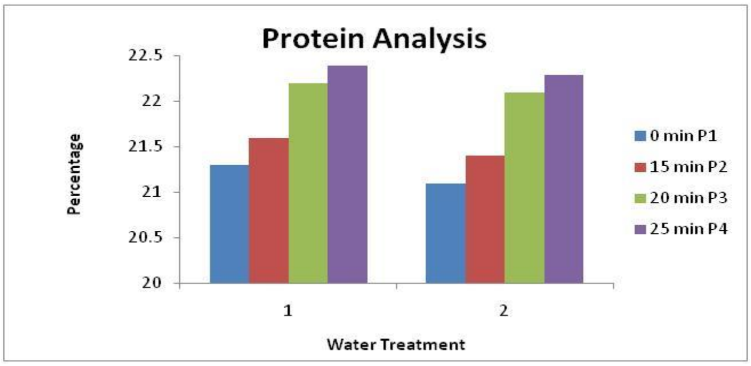

Figure 4: Graphical presentation of Protein Percentage per plant of the control and various Treatment groups.

3.4 Fresh Mass and Dry Mass

The mass analysis of Mung Beans for control and magnetically treated plants are shown in Table 3.4.

Table 3.4 The Mass Analysis in milligram of Mung Bean.

		Per Plant Mass in mg	
Min	Treatment	Fresh Mass	Dry Mass
Control	P1	218.6	34.2
15 min	P2	223.4	33.4
20 min	P3	224.6	36.3
25 min	**P4**	**224.6**	**36.2**

Table 3.4 The Mass Analysis in milligram of Mung Bean. Above table result showed that there was difference between control treatment and P1, P2, P3 treatment.

The effect of different exposure durations at a fixed magnetic field intensity (1.50 mT) on Shoot length development Magnetic field treatment of seeds leads to acceleration of plants growth, protein biosynthesis and root development [7, 20]. Moreover, we have observed more rapid plant development, which we assume is related to the reunion of the north and south magnetic dipoles and the energy released as a result of this reunion. Plant seedlings have been subjected to magnetic fields by other researchers in the past. The primary difference between our study and the articles analyzed is the exposure duration; we exposed the seeds to1.50 mT/time and did not add any other stress to the plant seeds. Some researchers have included a 45°C temperature stress and longer periods of magnetic field exposure. Magnetic field exposure to okra seeds gave more significant results when compared to electric and organic treatments [21]

IV. Conclusions

As a result of this study, the following conclusions are drawn:

- Magnetically treated seeds show significant growth rate of germination. Exposure time duration plays an important role in this treatment.
- Root length is increased by 12% in group P2, 21% in group P3 and 29% in group P4 comparison to control P1 for exposure of 1.5 mT magnetic fields. The combination of 1.5 mT field intensity for 25 minute exposure gives maximum germination rate.
- Shoot length is increased by 9% in group P2, 18% in group P3 and 29% in group P4 comparison to control P1 for exposure of 1.5 mT magnetic fields. In this case also exposure for 25 minute of 1.5 mT field intensity shows maximum fruitful result.
- No major impact of treatment observed on protein percentage with water and without water. Negligible differences are observed.
- No significant effect seen on fresh and dry mass per plant.

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